Review of California Energy Commission 2005 Requirements for Outdoor Lighting Senate Bill 5X

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1.0 Introduction

Review of the consultants draft report on proposed 2005 Energy Efficiency Standard for the California Energy Commission reveals that the proposed power densities for outdoor lighting will reduce the illumination levels by a factor of seven and in some other cases by a factor as high as fifteen or higher. As a result the illumination in many situations will result in serious safety issues including the handling of hazardous materials in improperly illuminated areas. The proposed illumination levels will result in a failure to communicate information that it was intended to be conveyed resulting in harm to businesses and the public. In this report typical power densities used presently are shown and comparison of these power density levels are made with those proposed.

2.0 Lighting Power Allowances (W/ft^2) and Existing Practices

Table 133 C of the proposed standard specifies levels of power densities for various lighting applications. Parts of this table are reproduced in the following:

Lighting Application	LZ1	LZ2	LZ3	LZ4
Retail Gas and Service station Canopies	0.7	1.00	1.25	2.00
All other sales Canopies	NA	0.7	1.00	1.25
Internally Illuminated Panel Signs	2.00	4.00	6.00	8.00
Externally Illuminated Signs	1.00	1.80	2.30	2.30

A typical Gas station canopy has an area of approximately 2000 square feet. Based on examination of typical practices in Canada and the USA such a canopy is lit with either 25-250 W or 25-175 watts metal halide lamps. In addition to the lighting for the area under the canopy, the periphery of the canopy is lit with either neon outline, or fluorescent lamps. If Neon lighting is used 10 transformers will be required at 250 Watts/transformer. If fluorescent lamps are used 6 high output ballasts are needed that will allow -20 ^{0}F lamp starting at 500 watts/ballast.

The total lighting power for the canopy is,
Area lighting: 4375 - 6250 Watts

Outline lighting neon:	2500 Watts
Or outline lighting fluorescent:	3000 Watts
Total metal halide + neon:	6875 - 8750 Watts
Total metal halide + Fluorescent:	7375 - 9250 Watts
Power density range:	3.4 - 4.625 Watts/ft^2

It must be noted that no inclusion of other lighting near the pumps is included in the above calculations. Also in the calculations the periphery is assumed to be red neon driven at 30 mA. If other colours were used cold temperature performance would dictate that the luminous tubing is driven at 60 mA. This would double the neon wattage. Inclusions of these wattages would make the required power densities considerably higher than the above values.
The proposed standard range allows 0.7 - 1.25 W/ ft^2. Even for lighting zone 4, which is undefined, the allowance is only 2 W/ft^2.

Outdoor sales canopies presently are lit with high output fluorescent lamps that are required to start at -20 ^{0}F. The power density for these areas is minimum of 15 W/ ft^2. This represents lighting with a single row of high output fluorescent lamps. Some situations require higher levels of illumination. The proposed standard allows levels of illumination that are at least fifteen times lower than those presently used!

Internally illuminated panel signs are lit with high output fluorescent lamps that are required to start at -20 ^{0}F. The power densities used in these areas are 15 W/ ft^2 and higher dependent on lamp length, the direction in which lamps must be oriented, the overlap between rows of lamps and cabinet thickness. The proposed standard only allows 2 to 8 W/ ft^2. To reduce wattage even in the most "liberal" LZ4 will require a 50% reduction in lamps. The visual appearance will be terrible. Most signs will not be conspicuous, legible or readable. Light output of all electric-discharge lighting, other than neon gas, declines proportional to reductions in ambient temperature. Marginalization of sign illumination at summer time temperatures will result in no visibility at lower ambient temperatures. Additionally there is no allowance for other decorative and aesthetically pleasing lighting often included with signs to create unique visual presentations.

Externally illuminated signs could use a variety of electric-discharge lighting sources including, fluorescent, neon and metal halide lamps. If fluorescent or neon is used the power density used would be in the range of 15 to 20 W/ ft^2 depending on the sign. If metal halide lamps are used for external sign illumination the power density is in the range of 5 to 10 W/ ft^2. The range allowed by the proposed standard is only 1 to 2.3 W/ ft^2.

Externally illuminated sign, which are most often "billboards", will not be readable.

3.0 Alternative Sources of Lighting for Signs

Earlier reports, related to the subject of energy saving, have concluded that we have available other sources of lighting that can be used to produce the necessary illumination of signs and provide considerable saving in energy. The conclusions in these reports have been based on the future potential of some technologies and not on what is available today. Further more, the need of the special type of light sources required for the illumination of signs has not been taken into account. The result has been that the efficacy of some of these sources has been exaggerated to the point of reducing the power densities allowable by the proposed standard to the unsafe low values of table 133C.

3 a. The Light Emitting Diode

One of these alternative sources considered is the light emitting diode (LED). Investigation of the state of the art in LED technology shows that the efficacy of these sources range from 1 lumen/watt the lowest to the best in the range of 20 lumens/watt. The efficacy of 20 lumens/watt is about only about 25% higher than red neon, depending on the neon tube diameter, and at least 3 times lower than the fluorescent lamps used presently in sign lighting. Further more, at 20 lumens/watt the efficient removal of heat from these LED's has not yet been dealt with. As a result the higher output LED system experience low life expectancy and fail even sooner when exposed to higher ambient temperatures. Thus this light source is still in its developmental stage as far as its use in signs is concerned.
In experiments carried out, taking the best LED available today which produces red colour, 1 watt was required to produce equivalent light to that produced by one foot of red neon tubing. A foot of red neon if driven by an efficient electronic power supply will require approximately 3 watts to produce a uniformly linear light that is acceptable in signs. To convert the point source light of LED's to linear light or light for backlighting areas of signs more energy will have to be expended and more materials will have to be used. This is because the light from the point source has to be diffused to simulate the neon tubing. Typically a 50% thicker diffuser is necessary to produce an even appearance. This thicker diffuser absorbs a significant percentage of the light produced by the LEDs. Thus any energy savings advocated in replacing red neon with LED's are non existent. With regards to colours other than red the technology of LED's has not yet produced sources to rival the arc discharge lamps in terms of efficacy.

White LEDs have very low life expectancy, extreme variance in light color and are not yet competitive with even incandescent bulbs.

3b. The T8 Lamp

Another form of lighting advocated in various related reports is the T8 fluorescent lamp. Even though the T8 lamp will produce higher efficacy than the T12 lamp, starting long lamps frequently used in signs at low temperatures will require starting voltages too high for the existing hardware (sockets, wiring) available to the sign industry.

4.0 Conclusions

The recommended light power density levels in the proposed standard will prove inadequate to service the needs of the public.
Experience of a major Canadian gas retailer where experiments with lighting canopies with 100 W metal halide lamps were attempted shows that the canopies of the test stations had to be re-ballasted and re-lamped with 175 W metal halide and in some cases with 250 W metal halide lamps. It became necessary to do this since dangerous materials are being dispensed in these facilities. Not every one using these facilities has 20/20 vision.
Reducing the power density of commercial canopies from the present minimum of 15 W/ft^2 to the levels proposed would render these canopies useless since they will become virtually invisible.
Internally illuminated signs are designed with the existing levels of power densities so they can be easily seen from the roadways and similar distances to help the public. The proposed levels will only be useful to people with perfect eyesight.
Externally illuminated signs use the existing power density for the same reasons as the internally illuminated signs.
New unproven technologies for outdoor sign lighting, such as T8 lamps and LED's have been advocated. However, this has been done without full consideration of all the parameters for effective outdoor sign lighting.
The use of T8 lamps will create light "hot spots" in existing plastic face signs because of the smaller diameter of these lamps. Redesigning the signs to take into account the 1" diameter of the T8 lamps will require deeper signs which will increase the amount of material used to make the signs. Deeper sign cabinets will result in reduced illumination of the sign face necessitating an increase in the number of T8 lamps in order to produce a legible sign face in at all temperatures. Existing signs however could not be equipped with the T8 lamps without a significant increase in the number of lamps and resultant energy consumption.
Review of reports on the progress of LED technology as a light source demonstrates clearly that even though the technology has potential, this

potential has not been realized yet. Further more the LED is a point source and signs have requirements for uniformly distributed light of all shapes. It is certain than in using LED's to simulate neon, for instance, more materials and energy per linear foot would have to be expended. The simulation of neon will most definitely increase the use of resources in both materials and energy. Thus why simulate linear neon lamps when you can use the real thing?

It appears that the proposed levels of lighting have been proposed on an ad hoc basis with no consideration given as to how they will effect our way of life.